Arizona Urban
Tree Map

Inventory Report Guide

i-Tree Streets Report Manual

Interpret Analysis and Reports for Arizona's Urban Tree Inventory

DRAFT 01/26/2015

Table of Content

I. Introduction

The materials presented in this urban tree inventory report guide are part of the Arizona Urban Tree Map (AZUTM www.azsf.gov/azutm) project, a collaboration of Arizona State Forestry (AZSF), University of Arizona School of Natural Resources and the Environment (SNRE) and USDA Forest Service (USDA-FS). Products created for this project include three urban tree identification Field Guides specific to the climate regions found in Arizona; a guide to the common insects and diseases found in Arizona urban trees; inventory data sheet templates; an instruction guide for collecting and uploading tree inventory data; and a web tool for information upload and data analysis. These products have been created to facilitate the collection of urban tree inventory data for Arizona's communities and the Arizona State Forestry Division.

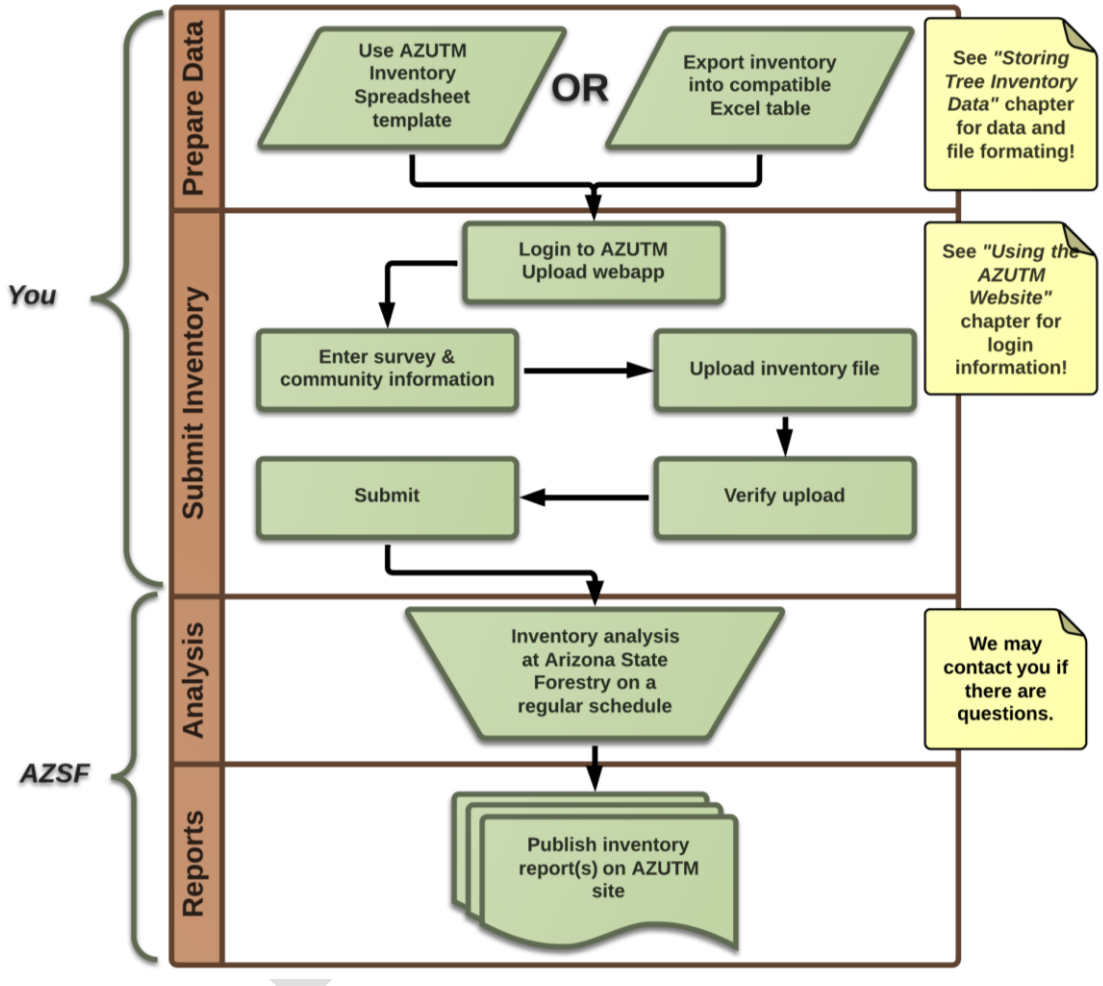

Figure 1. Flowchart of urban tree inventory report generation steps taken from the AZUTM Tree Inventory Instruction Guide at www.azsf.gov/azutm. See the Tree Inventory Instruction Guide for how to create and submit an urban tree inventory for analysis.

The primary objective of the AZUTM project is to develop an accessible tool that can be used to compile statewide urban forest information in a single, integrated location. This information will be used to determine the economic and environmental value of Arizona's urban forests (see Figure 1. Flowchart of urban tree inventory report generation steps taken from the AZUTM Tree Inventory Instruction Guide at www.azsf.gov/azutm. See the Tree Inventory Instruction Guide for how to create and submit an urban tree inventory for analysis.). A clear understanding of existing conditions will allow Arizona State Forestry, the USDA Forest Service, and local entities to identify

the strengths and weaknesses of our forestry resources, and develop long-term goals for urban forests. Because the database can be easily updated, it will be of great benefit to forest managers in both the short and long-term.

II. i-Tree Streets Analysis

Once an urban tree inventory has been completed and submitted to the AZUTM website, the Arizona State Forestry Division will process and analyze the submitted data with customized i-Tree Streets software. i-Tree Streets is an "analysis tool for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO^2 reduction, stormwater control, and property value increase." This free tool was developed and is maintained with the support of USDA-FS and can be downloaded at www.itreetools.org.

Figure 2. i-Tree logo

We chose i-Tree Streets to generate urban tree inventory and benefit reports because it is supported by USDA FS, is relatively easy to use, and is widely used by state and local communities nation-wide. i-Tree Streets provides estimated tree benefit factors for most major cities and towns in Arizona. We used the localized tree benefit prices - such as electricity costs and average home resale value – provided by i-Tree Streets for most major towns and cities in Arizona.

The i-Tree Streets program analyzes tree data by STRATUM Climate Zone and has assigned three Climate Zones for Arizona: Southwest Desert, North and Interior West (see Figure 3. i-Tree Streets Climate Zones). The program includes a standard tree species listing for each Climate Zone in the country. In order to aid in efficiency, the creators of i-Tree Streets also developed generic tree categories (e.g. broad-leaved deciduous, small) that could be used for species less common in urban areas. However, it is also possible to customize the list to the needs of the user. Because there are a number of species commonly planted in Arizona, modifications were made to the i-Tree Streets species lists for ease of data collection and more specific tree benefit analysis. For each i-Tree Streets climate zone (STRATUM Climate Zone) present in Arizona, custom i-Tree Streets species lists (using i-Tree Streets functional equivalents) were developed with industry professionals from southern and northern Arizona. Otherwise, i-Tree Streets will lump together missing species into generic tree categories.

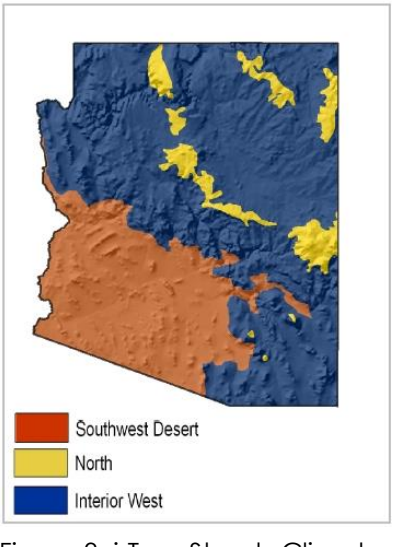

Figure 3. i-Tree Streets Climate Zones

For a list of modified and added species, see the LU_SPCODE tab in the AZUTM Tree Inventory Spreadsheet Template (Excel) file found on the AZUTM Resources page at www.azsf.gov/azutm. The LU_SPCODE tab contains a full list of: 1) all i-Tree Streets species; 2) our modifications to the species list highlighted in yellow; and 3) species added to the list for Arizona's Climate Zones highlighted in red.

Note: While AZUTM's Benefits reports are complete, the Cost and Cost Benefit Ratio analysis are incomplete because they require additional information specific to local horticultural practices and maintenance expenses - information that is not included or required in the AZUTM tree inventory upload.

III. AZUTM Tree Structure Reports

i-Tree Streets generates the following Excel Files that contain report tables and graphs on multiple tabs:

- BenefitOutputPublic.xlsx
- PopulationSummaryPublic.xlsx
- StructuralPublic.xlsx

A full description of the i-Tree Streets reports can be found in the i-Tree Streets Manual PDF starting on page 39 (www.itreetools.org/resources/manuals.php). A brief description of the report from the manual accompanies each report summary listed below.

A. Population Summary

Description: Tree count by species, DBH class, and tree type. In some cases, the population count will be summarized by inventory area (also called Zones in i-Tree Streets) on separate tabs.
Report Titles: "*Population Summary of Public Trees*"
Related Files and Tabs:

- PopulationSummaryPublic.xlsx
  - PopSummaryPublic
  - PopSummaryPublicZone

i-Tree Streets Description:

> *The Population Summary reports include summary tables and complete lists of inventoried species, their total numbers, numbers by tree type, and numbers by default DBH size classes. These reports provide a basic understanding of species frequencies citywide, by management zone and by DBH size class. Note that trees whose species codes have not been matched will appear at the bottom of the reports in the Unmatched category.*

B. Species Distribution of Top 10 Species

Description: Percent distribution table and pie chart for the top 10 species. Additional Excel tabs for each inventory area, called Zones in i-Tree Streets, may be also present.
Report Titles: "*Species Distribution of Public Trees*"
Related Files and Tabs:

- StructuralPublic.xlsx
  - SpeciesDistPublic
  - SpeciesDistPublicZone

i-Tree Streets Description:

> *The Species Distribution reports present data on species composition in the form of pie charts and tables for the 10 most common species, displayed in*

percentage of total numbers. These reports are helpful for understanding species dominance.

C. Relative DBH Class Distribution of Top 10 Species

Description: This report helps you to understand the size distribution, and, in turn, the age distribution throughout the trees in your inventory. It helps you plan for the future to understand when trees may begin to decline, and new trees should be planted. This report also includes tables and an area chart of the top most abundant tree species relative to count within each DBH Class. Diameter at Breast Height is used by i-Tree Streets as a stand-in for relative tree age which may be appropriate for some species but not for all.
Report Titles: "*Relative Age Distribution of Top 10 Public Tree Species (%)*"
Related Files and Tabs:

- `StructuralPublic.xlsx`
  - `RelativeAgeDistTop10Public`
  - `RelativeDistByZonePublic`

i-Tree Streets Description:

These reports are important for determining current management needs as well as anticipating how needs will change based on total numbers and aging of individual species. The distribution of ages within a tree population influences present and future costs as well as the flow of benefits. An uneven-aged population allows managers to allocate annual maintenance costs uniformly over many years and assure continuity in overall tree canopy cover. An ideal distribution has a high proportion of new transplants to offset establishment-related mortality, while the percentage of older trees declines with age.

D. Canopy Cover

Description: Table of all species that make up more than 1% of the total population relative to % Total Canopy Cover and other measures. % Total Canopy Cover is an estimate of how much shade is provided relative to tree species, size, and number of trees.

Note: There are several ways of calculating importance values for urban trees. I-Tree Streets' method may overestimate importance values in Arizona.

Report Titles: "*Importance Values for Most Abundant Public Trees*"
Related Files and Tabs:

- `StructuralPublic.xlsx`
  - `ImpValueBySpeciesPublic`
  - `CanopyCoverByZonePublic`

i-Tree Streets Description:

[Importance Values] are displayed in table form for all species that make up more than 1% of the population. The Streets IV is the mean of three relative values (percentage of total trees, percentage of total leaf area, and percentage of canopy cover) and can range from 0 to 100 with an IV of 100

suggesting total reliance on one species. IVs offer valuable information about a community's reliance on certain species to provide functional benefits. For example, a species might represent 10% of a population, but have an IV of 25% because of its great size, indicating that the loss of those trees due to pests or disease would be more significant than their numbers suggest.

E. Canopy Condition

Description: The custom tree Canopy Condition observation is a measure of overall tree health and is determined using the percent of canopy cover that is healthy. In general, it is a measure of how much of the canopy is in leaf versus how much deadwood is present. The following scale was developed for the AZUTM project to evaluate tree condition:

Good: >75% healthy tree cover. The leafy canopy is mostly healthy; there are few dead branches.
Fair: 50-75% healthy tree cover. The leafy canopy is more than half of the volume of the total canopy; there are dead branches but they are less than half the total canopy.
Poor: 25-50% healthy tree cover. The leafy canopy is less than half of the total canopy; the dead branches are more numerous than live branches.
Dead/Dying: <25% healthy tree cover. The leafy canopy is a small portion of the total canopy; dead branches substantially outnumber live branches.

Note: Do not confuse AZUTM's custom Canopy Condition observations with i-Tree Streets' Condition Categories. The latter describes similarly named four classes (Dead/ Dying, Poor, Fair, Good) of woody or foliage Replacement Factor Percent (RFP) – a more involved measurement or observation. According to i-Tree: "RFP values are used in calculating the replacement values of the trees using the Council of Tree and Landscape Appraisers (CTLA) method and reflect the relative structural integrity and health of a typical tree in the given condition."

Report Titles: "*Canopy Condition for Public Trees by Zone*" and "*Canopy Condition for Public Trees by Species*"
Related Files and Tabs:

- `StructuralPublic.xlsx`
  - `CanopyConditionByZone`
  - `CanopyConditionBySpecies`

F. Insect Observations

Description: Custom AZUTM observation of insect presence or absence on each tree. Insect or disease identification can be challenging. Early detection is the best way to prevent insect and disease outbreak in your urban forest. Therefore, the AZUTM project includes a guide to aid in insect and disease identification. The AZUTM Insect and Disease Field Guide can be found under the Resources webpage at www.azsf.gov/azutm
Report Titles: "*Insects for Public Trees by Zone*" and "*Insects for Public Trees by Species*"
Related Files and Tabs:

- `StructuralPublic.xlsx`
  - `InsectsByZone`
  - `InsectsBySpecies`

G. Disease Observations

Description: Custom AZUTM observation of disease agent presence or absence on each tree. Insect or disease identification can be challenging. Early detection is the best way to prevent insect and disease outbreak in your urban forest. Therefore, the AZUTM project includes a guide to aid in insect and disease identification. The AZUTM Insect and Disease Field Guide can be found under the Resources webpage at www.azsf.gov/azutm
Report Titles: "*Diseases for Public Trees by Zone*" and "*Diseases for Public Trees by Species*"
Related Files and Tabs:

- StructuralPublic.xlsx
  - DiseasesByZone
  - DiseasesBySpecies

IV. AZUTM Tree Benefit Reports

i-Tree Streets generates the following Excel Files that contain report tables and graphs on multiple tabs:

- BenefitOutputPublic.xlsx
- PopulationSummaryPublic.xlsx
- StructuralPublic.xlsx

A full description of i-Tree Streets reports can be found in the i-Tree Streets Manual PDF starting on page 39 (www.itreetools.org/resources/manuals.php). A brief description of the report from the manual accompanies each report summary listed below.

> **Note:** While AZUTM's Benefits reports are complete, the Cost and Cost Benefit Ratio analysis are incomplete because they require additional information specific to local horticultural practices and maintenance expenses - information that is not included or required in the AZUTM tree inventory upload.

A. Average and Total Annual Benefits

Description: The tables and bar charts presented here are a snapshot of the total benefits of the current inventory entered into the analysis for each species, in dollars.
Report Titles: "*Average Annual Benefits of Public Trees by Species ($/tree)*" and "*Average Annual Benefits of Public Trees by Species*"
Related Files and Tabs:

- BenefitOutputPublic.xlsx
  - AverageAnnualBenefitsPublic

i-Tree Streets Description:

> *The Summary report presents the annual total of energy, stormwater, air quality, carbon dioxide, and aesthetic/other benefits. Values are dollars per tree or total dollars.*

B. Annual Energy Benefits

Description: Tables showing the estimated annual energy cost benefits per species and inventory area (Zone).

Note: i-Tree Streets provides estimated tree benefit factors for most major cities and towns in Arizona. Although they can be customized, we did not modify them.

Report Titles: "*Annual Energy Benefits of Public Trees by Species*" and "*Annual Energy Benefits of Public Trees by Zone*"
Related Files and Tabs:

- `BenefitOutputPublic.xlsx`
  - `NetAnnualEnergyPublic`

i-Tree Streets Description:

> *The Energy report presents the contribution of the urban forest toward conserving energy in terms of reduced natural gas use in winter (measured in therms or gigajoules) and reduced electricity use for air conditioning in summer (measured in kilowatt-hours or gigajoules).*

C. Annual Stormwater Retention Benefits

Description: This represents the amount of water not entering the storm water system, saving money with reduced flow due to infiltration of water and interception of rain by the trees. This report includes tables showing the estimated annual Stormwater retention benefits per species and inventory area (Zone).

Note: i-Tree Streets provides estimated tree benefit factors for most major cities and towns in Arizona. Although they can be customized, we did not modify them.

Report Titles: "*Annual Stormwater Benefits of Public Trees by Species*" and "*Annual Stormwater Benefits of Public Trees by Zone*"
Related Files and Tabs:

- `BenefitOutputPublic.xlsx`
  - `NetAnnualStormwaterPublic`

i-Tree Streets Description:

> *The Stormwater report presents the reductions in annual stormwater runoff due to rainfall interception by trees (measured in gallons or cubic meters).*

D. Total CO_2 Storage Benefits

Description: These tables show the estimated current net carbon dioxide storage benefits of reported trees per species and inventory area (Zone). Carbon storage refers to the amount of CO_2 trees store in woody biomass over the life of the tree or products made from that biomass (e.g. furniture or lumber).

Note: i-Tree Streets provides estimated tree benefit factors for most major cities and towns in Arizona. Although they can be customized, we did not modify them.

Report Titles: "*Stored CO2 Benefits of Public Trees by Species*" and "*Stored CO2 Benefits of Public Trees by Zone*"
Related Files and Tabs:

BenefitOutputPublic.xlsx
CarbonStoragePublic

i-Tree Streets Description:

> *Whereas the [below] report quantifies annual CO_2 reductions, the Carbon Stored report tallies all of the carbon dioxide stored in the urban forest over the life of the trees as a result of sequestration (in pounds or kilograms). It should not be added to the Carbon Dioxide value or double-counting will occur.*

E. Net Annual CO_2 Sequestration Benefits

Description: As opposed to the carbon storage, carbon sequestration refers to the amount of CO_2 actually removed from the atmosphere. An example of a use of benefits would be an offset of vehicle and/or power plant emissions. This report/section includes tables showing the estimated net annual atmospheric carbon dioxide reduction benefits per species and inventory area (Zone).

Note: i-Tree Streets provides estimated tree benefit factors for most major cities and towns in Arizona. Although they can be customized, we did not modify them.

Report Titles: "*Annual CO2 Benefits of Public Trees by Species*" and "*Annual CO2 Benefits of Public Trees by Zone*"
Related Files and Tabs:

BenefitOutputPublic.xlsx
NetAnnualCO2BenefitsPublic

i-Tree Streets Description:

> *The Carbon Dioxide report presents annual reductions in atmospheric CO_2 due to sequestration by trees and reduced emissions from power plants due to reduced energy use (in pounds or kilograms). The model accounts for CO_2 released as trees die and decompose and CO_2 released during the care and maintenance of trees.*

F. Annual Air Quality Benefits

Description: The figures show estimated benefits and costs provided by trees by species and inventory area (Zone).

Note: i-Tree Streets provides estimated tree benefit factors for most major cities and towns in Arizona. Although they can be customized, we did not modify them.

Report Titles: "*Annual Air Quality Benefits of Public Trees by Species*" and "*Annual Air Quality Benefits of Public Trees by Zone*"
Related Files and Tabs:

BenefitOutputPublic.xlsx
NetAnnualAirQualityPublic

i-Tree Streets Description:

The Air Quality report quantifies the air pollutants (O_3, NO_2, SO_2, PM_{10}) deposited on tree surfaces and reduced emissions from power plants (NO_2, PM_{10}, VOCs, SO_2) due to reduced electricity use (measured in pounds or kilograms). Also reported are the potential negative effects of trees on air quality due to BVOC emissions.

G. Annual Property Value Benefits

Description: The tables demonstrate estimated property value benefits of trees per species and inventory area (Zone). This report can show how trees positively affect property value based solely on the presence, type, and DBHof the tree.

Note: i-Tree Streets provides estimated tree benefit factors for most major cities and towns in Arizona. Although they can be customized, we did not modify them.

Report Titles: "*Annual Aesthetic/Other Benefit of Public Trees by Species*" and "*Annual Aesthetic/Other Benefit of Public Trees by Zone*"
Related Files and Tabs:

- `BenefitOutputPublic.xlsx`
  - `AverageAnnualBenefitsPublic`

i-Tree Streets Description:

The Aesthetic/Other report presents the tangible and intangible benefits of trees reflected in increases in property values (in dollars).

H. Miscellaneous Reports

The spreadsheets may contain additional automatically generated tabs with reports that are not relevant because tree cost estimates were not included in the initial analysis. These tree cost and cost-benefit ratio reports use place-holder cost values without regard to local conditions and should be disregarded.

V. Terms and Definitions

Term	Definition
AZSF	Arizona State Forestry Division – home of AZUTM
AZUTM	Arizona Urban Tree Map, an AZSF project in support of urban forest inventories hosted at www.azsf.gov/azutm
Climate Zone	STRATUM Climate Zones developed by USDA FS and used by i-Tree Streets
DBH	Diameter at Breast Height
FS	USDA Forest Service – provided funding to AZUTM
SNRE	University of Arizona School of Natural Resources and the Environment – an AZUTM partner
STRATUM	i-Tree Street precursor developed by USDA Forest Service' s "Urban Ecosystems and Processes" team
tab	Worksheet within an Excel spreadsheet file; also called "sheet," "sheet tab," or "worksheet tab"
USDA	United States Department of Agriculture
Zone	i-Tree Streets' term for a tree inventory area within a community

VI. Credits and References

Photo and Figure Credits
Figure 2: i-Tree logo, USDA Forest Service. i-Tree

References
USDA Forest Service. i-Tree web page, www.itreetools.org
USDA Forest Service. i-Tree Streets User's Manual, www.itreetools.org

Special thanks to the pilot inventory communities:

City of Bisbee
Lake Havasu City
City of Mesa
Town of Prescott Valley
Town of Pinetop-Lakeside
Arizona State Parks: Oracle State Park
University of Arizona Campus Arboretum

Publication information: Arizona State Forestry Division – Urban and Community Forestry (February, 2015). Arizona Urban Tree Inventory Report Guide. Retrieved from http://azsf.gov/azutm

Major funding provided by the USDA Forest Service State and Private Forestry Program. Collaborators include the University of Arizona Campus Arboretum and the School of Natural Resources and the Environment.